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APPRENTICESHIP TRAINING

WELDER
Program

Alberta

MANPOWER
Apprenticeship and Trade Certification

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TABLE OF CONTENTS

The Goal of Apprenticeship Training	1
Basic Requirements	2
Credits	2
Benefits	2
Directions for Prospective Apprentices	3
Apprenticeship Route Toward Certification	4
Apprenticeship Committee Structure	5
Apprenticeship Committee Members	5
Procedures for Recommending Revision(s) to the Course Outline	6
Safety Education	6
Subjects and Time Distribution	8

COURSE OUTLINE

First Period Subjects	9
Second Period Subjects	16
Third Period Subjects	21
Suggested Reference Materials	25
Technical Training Schools	25
Location of Apprenticeship and Trade Certification Regional Offices	26
Trade Regulations	27

WELDER TRADE

THE GOAL OF APPRENTICESHIP TRAINING

To develop a competent tradesman who, through skill and knowledge, is capable of displaying productive performance in the welding industry.

THE PRODUCT OF APPRENTICESHIP — a graduate who is able to:

- ★ Be skillful in the fusing of metals using prescribed welding applications.
- ★ Have a working knowledge of the welding equipment involved with the various welding procedures.
- ★ Comprehend blueprints and develop layout patterns for projects and calculate quantities of materials.
- ★ Have a thorough knowledge of metals, arc electrodes, welding gases and gas welding filler rods.
- ★ Recognize defective welds, a knowledge as to the cause, and proper procedure for the repair of the defective area.
- ★ Have a working knowledge of mathematics calculations pertaining to the welding trade.
- ★ Have a working knowledge of the required codes.
- ★ Be familiar with the work of other tradesmen in affiliated trades.

WELDER APPRENTICESHIP INFORMATION

Basic Requirements:

- ★ Indenture for three periods of Trade experience.
- ★ Attend a six week technical training course in the first period and eight weeks in the second and third periods.
- ★ Fulfill the requirements for each period including 1800 hours of work experience inclusive of time spent at the training course; successfully complete the technical training course and obtain a satisfactory employer's report.
- ★ Education — a minimum requirement is the completion of grade 9 or a pass on an equivalent entrance examination as prescribed by the Trade regulation.
- ★ Age — the minimum age for apprentices is 16 years. There is no upper age limit.

Credits:

- ★ Accelerated patterns of apprenticeship may be granted for related technical training and/or experience.

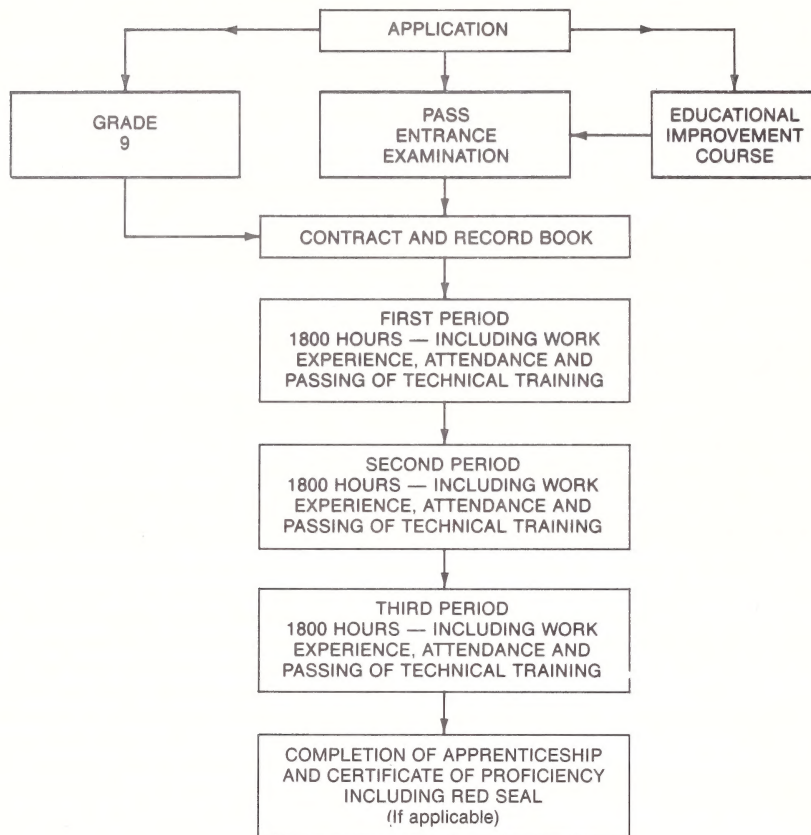
Benefits:

- ★ Apprenticeship is a learning-while-earning program. During the apprenticeship period, while working at the trade, apprentices are assured by regulation of a minimum percentage of the prevailing journeyman rate: 60% during the first period, 75% during the second period, 90% during the third period. Progress from one rate to the next takes place only after successful completion of all the requirements for each period. (details are outlined in the Record Book).
- ★ All apprentices 17 years of age and older are normally eligible for training allowances while attending technical training courses. These allowances are funded by the Canada Employment and Immigration Commission.
- ★ Administrative procedures establishing the amount of training allowance is complex and can vary with an individual's circumstances. Contact a local Canada Employment Centre for details.
- ★ An apprentice who successfully completes the program will graduate with an Alberta Completion of Apprenticeship Certificate and a Certificate of Proficiency with the Interprovincial Red Seal.
- ★ The most significant benefit to the graduate apprentice is that he is well trained in technical and practical aspects of the trade and is able to make a worthwhile and productive contribution to society. Society in return, will provide an opportunity for an above-average income and successful livelihood.

DIRECTIONS FOR PROSPECTIVE APPRENTICES

- ★ Contact your nearest Apprenticeship and Trade Certification office for detailed information and counselling (see list of offices on page 25).
- ★ Obtain an application form in duplicate from the Apprenticeship and Trade Certification office and neatly complete, on both copies, the information requested from the apprentice.
- ★ Contact in person firms that employ Welders and apply for an apprentice position. Present your apprentice application forms to the person who interviews you so that he will know who you are and what you can offer his firm.
- ★ Persevere in the search for apprentice employment and upon obtaining employment, leave the application with the employer.
- ★ Attach to the apprentice application a copy (transcript) of the marks for your last year of school. Applicants who do not have their school transcripts or a grade nine standing are required to write an entrance examination. If transcripts have been lost, contact Alberta Education for information on school transcripts.
- ★ Any time credit, for previous experience in the Welder trade, should be discussed with the employer and requested on the application form by the employer.
- ★ A contract of apprenticeship is entered into between the apprentice and the employer and should be signed within three months after the apprentice application has been approved. If contracts have not been issued within this time, contact the Apprenticeship and Trade Certification office.
- ★ Before signing the contract of apprenticeship read the complete document carefully — know your obligations and responsibilities to your employer — know the employer's obligations and responsibilities to you — feel confident you have selected the right occupation.
- ★ Know when you will be expected to attend classes and be prepared to attend. School schedules will be sent to your employer and notice to attend classes will be sent to you.
- ★ Prepare in advance for the financial obligations required of you during school training. Reference materials and school supplies are paid for by the apprentice.
- ★ While an apprentice, it will be your responsibility to respond promptly to mailed directions and requests from Apprenticeship and Trade Certification.

APPRENTICESHIP ROUTE TOWARD CERTIFICATION



APPRENTICESHIP COMMITTEE STRUCTURE

Welder Provincial Apprenticeship Committee

The Provincial Apprenticeship Committee for the Welder Trade is comprised of members from Local Apprenticeship Committees from the cities of Edmonton, Calgary, Fort McMurray, Grande Prairie, Lethbridge, Medicine Hat, Red Deer, Hinton, and Peace River.

This Committee is concerned with the policies that guide the program and make recommendations to the Apprenticeship and Trade Certification Board and the Executive Director of Apprenticeship and Trade Certification in the following areas:

- ★ Contribute current information relative to changes in the trade and requirements of industry.
- ★ Make recommendations for changes to existing trade regulations.
- ★ Assist in updating of the training program through recommendations for revisions to the course outline and attendant examinations.

Welder Local Apprenticeship Committee

Local Apprenticeship Committees are concerned with individuals and trade situations within a local region. Meetings are held throughout the year to make recommendations and to discuss problems relating to the apprenticeship program. Members who serve on committees are nominated by employer and labour organizations, and membership is equally divided into employer and employee representation in accordance with The Manpower Development Act.

Apprenticeship Committee Members:

Mr. L. Paniccia — Edmonton — Employer
Mr. R. Bedyk — Edmonton — Employee
Mr. A. Loyer — Edmonton — Employee
Mr. C. Taylor — Edmonton — Employer
Mr. D. Habiak — Edmonton — Employee (Alternate)
Mr. W. Spielman — Calgary — Employer
Mr. W.G. Sheppard — Calgary — Employer
Mr. M.G. Klassen — Calgary — Employee
Mr. L.C. Brazeau — Calgary — Employee
Mr. H. Chipchase — Calgary — Employer (Alternate)
Mr. D.A. Golosky — Fort McMurray — Employer
Mr. J.E. Penner — Fort McMurray — Employer
Mr. D. Provencal — Fort McMurray — Employee
Mr. L.J. Henderson — Fort McMurray — Employee
Mr. T. McEwen — Grande Prairie — Employer
Mr. D.R. Jones — Grande Prairie — Employee
Mr. N.W. Phillips — Lethbridge — Employer
Mr. D.L. Palmer — Lethbridge — Employer (Alternate)
Mr. B.J. Liverseed — Lethbridge — Employee
Mr. G.P. Gerhardt — Lethbridge — Employee (Alternate)
Mr. G. Androkovich — Lethbridge — Employer
Mr. K. Rothe — Lethbridge — Employee
Mr. H. Enslin — Medicine Hat — Employer
Mr. R. Richter — Medicine Hat — Employer
Mr. R. Hipkins — Medicine Hat — Employee
Mr. H. Hollman — Red Deer — Employee
Mr. T.W. Brown — Hinton — Employer
Mr. L. Keyes — Hinton — Employer
Mr. E. Martin — Hinton — Employee
Mr. H. Setz — Peace River — Employer
Mr. L.W. Zwick — Peace River — Employee

WELDER PROGRAM COURSE OUTLINE

This outline has been prepared in accordance with recommendations from the Provincial Apprenticeship Committee for the Welder Trade in the Province of Alberta.

The outline was updated following consideration given to recommendations and suggestions from:

Local Apprenticeship Committees
Representatives from training institutes
Curriculum Sub-Committee from the Provincial Apprenticeship Committee

PROCEDURES FOR RECOMMENDING REVISION(S) TO THE COURSE OUTLINE

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to Apprenticeship and Trade Certification, Edmonton.

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

SAFETY EDUCATION

Safe working procedures and conditions, accident prevention and the preservation of health is of primary importance in the Apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of the government, employers, employees and the general public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm and that safe learning experiences and environment can be created by controlling the variables and behaviors that may contribute to or cause an accident and/or an injury.

It is generally recognized that a safe attitude contributes to an accident free environment. As a result a healthy safe attitude towards accidents will benefit an employee by helping to avoid injury, loss of time and loss of pay.

A tradesman is possibly exposed to more hazards than any other person in the work force and therefore, should be familiar with the Occupational Health and Safety Act and Regulations dealing with his own personal safety and the special safety rules applying to each job.

LEGAL AND ADMINISTRATIVE ASPECTS

Employer's Responsibilities:

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer. The company is responsible for:

1. The provision and maintenance of safety equipment
2. The provision of protective devices and clothing (as required by the Occupational Health & Safety Act, General Safety Regulations)
3. The enforcement of safe working procedures
4. Adequate safeguards for machinery, equipment and tools
5. Observance of all accident prevention regulations
6. Adequate training to allow a worker to use or operate equipment in an effective and safe manner.

Government's Responsibilities:

Apprenticeship and Trade Certification in conjunction with the respective Provincial Apprenticeship Committee assumes the responsibility to assure that adequate safety is reflected in the curriculum and that adequate safety instruction is presented at the training establishments.

The Occupational Health and Safety Inspection Branch assumes the responsibility for periodic inspection of the operation to ensure that regulations for industry are being correctly observed.

Individual's Responsibilities:

The employee is responsible for:

1. Knowing and working in accordance with the safety regulations pertaining to job environment and
2. Working in such a way as not to endanger himself or his fellow employees

The major factor in safety is the individual employee, his personal attitude toward safety and having an awareness of the respective safety regulation.

WELDER PROGRAM

Subjects

Time Distribution Hours

	First Period	Second Period	Third Period	Totals
O.A.W.	39	43		82
S.M.A.W.	64	68	112	244
G.M.A.W.	19			19
G.T.A.W.		37	24	61
S.A.W. & F.C.A.W.	2			2
Hand Tools	6			6
Rigging		6		6
Safety	6			6
Trade Problems	15	15		30
Codes			12	12
Blueprint Reading		6	48	54
Trade Science			12	12
Pattern Development		27		27
Review		6	6	12
Examinations				
Theory	15	18	15	48
Practical	9	9	6	24
Registration	5	5	5	15

FIRST PERIOD: 6 WEEKS AT 30 HOURS PER WEEK FOR 180 HOURS

SECOND PERIOD: 8 WEEKS AT 30 HOURS PER WEEK FOR 240 HOURS

THIRD PERIOD: 8 WEEKS AT 30 HOURS PER WEEK FOR 240 HOURS

FIRST PERIOD TECHNICAL TRAINING WELDER TRADE

TOPIC

COURSE OBJECTIVES

Upon successful completion of each section the apprentice should be able to:

A. Oxyacetylene Welding

1. Oxyacetylene equipment

3 Hours

(a) cylinders

1. Describe the construction of oxygen and acetylene cylinder.
2. Describe the different sizes of cylinders.
3. Explain the procedure for handling, transporting and storing cylinders.
4. State the procedure for handling faulty cylinders.
5. Explain the procedure for filling cylinders.
6. Explain the construction and purpose of a manifold system.

(b) regulators

1. Describe the purpose of a regulator.
2. Describe the basic construction and pressures involved for a single stage and a double stage regulator.

(c) hoses

1. Explain the construction of hoses.
2. Identify hoses and fittings.
3. Explain the C.S.A. specifications of hoses.
4. State the procedure for the repair and maintenance of hoses.

(d) tips

1. Describe the design and construction of welding tips.
2. Explain the operating principles of a welding tip.
3. Describe and demonstrate:
 - (a) care and maintenance of tips
 - (b) correct selection of tips

2. Setting-up

2 Hours

1. Explain and demonstrate the correct placement and securing of cylinders.
2. Explain and demonstrate the clearing and checking of cylinder valves.
3. Attach regulators safely and correctly.
4. Attach hoses and explain reason for cleaning new hoses.
5. Attach correctly the barrel and tip.
6. Explain the correct procedure in checking for leaks.
7. Check to assure that the regulators were not used for any other purpose than for what they were intended.

3. Pressures and flame adjustments

1 Hour

1. Explain and demonstrate the correct regulator adjustments and balancing pressures.
2. List the reasons for backfires and flashbacks.
3. Define flame propagation.
4. Ignite the torch using the recommended striker.
5. Explain and demonstrate the different types of flames and uses.
6. List and demonstrate the acceptable shutting down procedure.

4. Welding gases		1 Hour
	<ol style="list-style-type: none"> 1. Explain the production of acetylene gas. 2. Explain the production of oxygen. 3. Compare the uses of: <ol style="list-style-type: none"> (a) methylacetylene propadiene (b) natural gas (c) propane 	
5. Filler rods and fluxes		1 Hour
(a) filler rods	<ol style="list-style-type: none"> 1. List the types of filler rods. 2. Explain the composition of the filler rods. 3. Describe the sizes and shapes of filler rods. 4. Select the appropriate filler rod. 5. Explain the strength and limitations of filler rods. 	
(b) fluxes	<ol style="list-style-type: none"> 1. List the purposes of flux. 2. List the types of fluxes. 3. Describe and demonstrate the methods of application. 4. Explain and demonstrate the removal of flux. 	
6. Manual and semi-automatic cutting		4 Hours
	<ol style="list-style-type: none"> 1. List and explain torch designs. 2. List and explain tip designs. 3. Describe: <ol style="list-style-type: none"> (a) aids in cutting (b) straight and bevel cutting (c) piercing holes and stack cutting (d) machine cutting (e) pipe cutting (f) plasma arc cutting 4. List and describe the various gases used for cutting and their applications. 	
7. Brazing		1 Hour
	<ol style="list-style-type: none"> 1. Explain the theory of adherence. 2. Explain and demonstrate the preparation of material. 	
8. Identification of metals		1 Hour
	<ol style="list-style-type: none"> 1. Describe and demonstrate the common methods of identifying metals. 	
9. Lab practices		25 Hours
(a) butt welds	<ol style="list-style-type: none"> 1. Demonstrate the ability to perform butt welds on 10 or 11 ga (3.00 — 3.25 mm) mild steel in the flat, vertical and overhead positions, using a comparable filler material. 2. Demonstrate the ability to perform butt welds on 16 ga (1.5 mm) mild steel in the flat and vertical position using a comparable filler material. 	
(b) lap welds	<ol style="list-style-type: none"> 1. Demonstrate the ability to perform lap welds on 10 or 11 ga (3.00 — 3.25 mm) mild steel, in the vertical position using a coated tobin bronze filler material. 2. Demonstrate the ability to perform lap welds on 10 or 11 ga (3.00 — 3.25 mm) and on 16 ga (1.5 mm) mild steel, in the vertical and horizontal overhead position using a comparable filler material. 	

TOPIC	COURSE OBJECTIVES	
(c) oxyacetylene cutting	1. Perform straight line and bevel cutting on available mild steel. 2. Pierce and cut holes in mild steel plate. 3. Cope 3/8" mild steel to fit a 4" channel member.	
(d) demonstrations	1. Observe and explain the principle of aluminum and silver brazing. 2. Observe and explain the principle of welding zinc die cast. 3. Observe and explain the principle of plasma arc cutting.	
B. Shielded Metal Arc Welding		
1. Arc welding machines	1. Describe the basic components and operation of an alternating current transformer. 2. Describe the basic components and operation of A.C. — D.C. rectifier. 3. Describe the basic component and operations of an A.C. and D.C. generator. 4. List the advantages and disadvantages of the various types of welding machines.	1 Hour
2. Selecting and installing welding machines	1. Explain the reasons for selecting a welding machine for a specific task. 2. Explain the consideration to be taken when installing a welding machine in a shop environment.	1 Hour
3. Maintenance of welding machines	1. Explain the day to day maintenance required for welding machines.	1 Hour
4. Accessories for welding machines	1. Describe cable construction. 2. Explain cable sizing. 3. Describe the various types of electrode holders and explain the maintenance required. 4. Describe: <ul style="list-style-type: none"> (a) cable lugs (b) quick connectors (c) ground clamps 	1 Hour
5. Basic electricity	1. Define open circuit voltage. 2. Define arc voltage. 3. Define alternating current and direct current. 4. Define resistance. 5. Explain duty cycle. 6. Define reverse and straight polarity. 7. Explain the heat distribution using reverse or straight polarity. 8. Explain voltage loss.	1 Hour
6. Machine controls	1. Describe the controls on a welding machine. 2. Explain the arc characteristics in relation to the different voltage and amperage settings.	1 Hour

TOPIC

COURSE OBJECTIVES

3. Explain an illustrate the volt-amp curve.
4. Explain the functions of voltage and amperage.

7. Mild steel arc welding electrodes

2 Hours

1. Explain the numerical definitions of electrodes.
2. Explain the manufacturing specification control.
3. List the functions of coating.
4. List the functions of the slag.
5. Explain the effects of alloy additions to the coating.
6. Explain static and dynamic loading.

8. Safety

6 Hours

1. Describe and wear proper welding apparel.
2. Describe and wear proper welding goggles.
3. Describe the process for fireproofing materials.
4. State the use of protective screens.
5. Describe a welding helmet and illustrate the proper placement of lenses.
6. Describe and illustrate safe housekeeping practices.
7. List the rays involved with welding and the effects associated with these rays.
8. Describe the procedures to protect oneself and the general public from harmful rays.
9. Describe the procedure for entry and welding in confined areas.
10. List the reasons for the grounding of electrical equipment.
11. Describe the procedures for rendering a vessel safe for welding.
12. Describe the procedure for welding of a boxed in section.
13. Explain the hazards involved with:
 - (a) H²S gas
 - (b) SO² gas
14. Explain the procedure for administering first aid for minor injuries.
15. List the different type of extinguishers and their uses.
16. Explain the precautions to be taken, before welding on motor vehicles.
17. Demonstrate an ability to locate and interpret sections of the Occupational Health and Safety Act, General Safety Regulations as they apply to welding.

9. Hand tools

6 Hours

1. Demonstrate the safe use and maintenance of grinders as they apply to the welding industry:
 - (a) define the application of the various types of grinding discs and grinding wheels
2. Demonstrate and describe:
 - (a) safe use of drills
 - (b) bit sharpening and sizing
 - (c) use of coolants
3. Demonstrate the safe use and maintenance of:
 - (a) layout tools
 - (b) files
 - (c) hammers
 - (d) chisels

TOPIC	COURSE OBJECTIVES	
	(e) hacksaws (f) wrap arounds	
10. Basic joints	1. List and describe the five basic joints. 2. Describe the variations and limitations of the five basic joints.	1 Hour
11. Types of welds	1. List and describe the four types of welds. 2. Explain how the welds apply to the various types of joints.	1 Hour
12. Welding symbols	1. Explain the purpose of weld symbols. 2. Define: (a) weld symbol (b) welding symbol 3. Draw and interpret elementary: (a) weld symbols (b) welding symbols	6 Hours
13. Weld faults	1. Define and explain what constitutes: (a) dimensional defects (b) notch effects (c) surface and internal defects (d) defective properties	1 Hour
14. Lab practices		47 Hours
(a) stringer beads	1. Demonstrate the ability to weld stringer beads on available mild steel in the flat and vertical position using E6010 and E6012 filler material.	
(b) lap welds	2. Demonstrate the ability to weld lap welds on 3/8" (10 mm) mild steel in the flat, vertical and horizontal overhead positions using E6010, E6013 and E7018 filler material.	
(c) tee welds	3. Demonstrate the ability to weld tee welds on available mild steel in the flat and flat horizontal position using E7024 and E7027 filler material.	
(d) butt welds	4. Demonstrate the ability to weld a flat butt weld on 3/8" (10 mm) mild steel using E6010 or E6011 filler material.	
(e) carbon arc gouging	5. Describe and demonstrate carbon arc gouging on available mild steel.	
(f) demonstrations	6. Observe and explain the process of: (a) spot welding (b) stud welding	
C. Gas Metal Arc Welding		
1. Power source	1. Describe the power sources preferred for G.M.A.W.	2 Hours
(a) constant voltage	1. Explain the purpose of constant voltage.	
(b) slope	1. Explain the purpose of slope control.	
(c) inductance	1. Explain the purpose of inductance.	
(d) metal transfer	1. Describe the three types of metal transfer.	

TOPIC	COURSE OBJECTIVES	
2. Wire drive systems	1. Describe the operation of three types of wire drive systems.	1 Hour
3. Shielding gases	1. Explain the purpose of shielding gases. 2. Identify the various types of shielding gases and their uses.	1 Hour
4. Regulator/flow meters	1. Explain the purpose of a regulator/flow meter. 2. Describe the operation and maintenance of a regulator/flow meter.	
5. Wire classification	1. Interpret mild steel wire classification. 2. Explain wire sizes and storage.	1 Hour
6. Maintenance	1. Describe and demonstrate the maintenance for: (a) wire feed (b) nozzle (c) contact tube (d) wire feed cables (a) advantages and disadvantages (b) defects	2 Hours
7. Lab practices	1. List the advantages and disadvantages of G.M.A.W. 1. Diagnose and demonstrate corrective measures for G.M.A.W.	12 Hours
(a) lap welds	1. Demonstrate the ability to weld lap welds on 3/8" (10 mm) mild steel in the flat, vertical and horizontal positions. 2. Demonstrate the ability to weld lap welds on 10 ga or 11 ga (3.00 — 3.25 mm) mild steel in the flat, vertical and horizontal positions.	12 Hours
(b) tee welds	1. Demonstrate the ability to weld tee welds on mild steel (available material) in the horizontal flat and vertical positions.	
(c) butt welds	1. Demonstrate the ability to weld butt welds on 3/8" (10 mm) mild steel in the flat, vertical, overhead and horizontal positions.	
8. Demonstrations	1. Observe and explain the process of: (a) submerged arc welding (b) flux core arc welding (c) dual-shield arc welding	2 Hours
D. Trade Problems		15 Hours
1. Whole numbers and fractions	1. Solve problems using whole numbers and fractions in: (a) addition (b) subtraction (c) division; and (d) multiplication	
2. Decimals	1. Solve problems using decimal numbers in: (a) addition (b) subtraction (c) division; and (d) multiplication 2. Change decimal numbers to fractions and vice versa.	

TOPIC

COURSE OBJECTIVES

3. Percentages and ratio

1. Calculate percentage and ratio using:
 - (a) decimal
 - (b) fractions
 - (c) whole numbers

4. Perimeters and areas

1. Calculate perimeters and areas of:
 - (a) squares
 - (b) rectangles
 - (c) circles
 - (d) parallelograms

5. Volumes

1. Calculate volumes of:
 - (a) square containers
 - (b) rectangular containers
 - (c) cylindrical containers

6. Conversions

1. Convert:
 - (a) feet to inches and vise versa
 - (i) square inches to square feet and vise versa
 - (b) cubic inches to cubic feet and vise versa
 - (c) cubic measures to gallons
 - (d) U.S. gallons to imperial gallons
 - (e) fahrenheit to celsius and vise versa

7. Metrics

1. Calculate
 - (a) areas
 - (b) volumes
 - (c) linear measurements
 - (d) weights

SECOND PERIOD TECHNICAL TRAINING WELDER TRADE

TOPIC

COURSE OBJECTIVES

Upon successful completion of each section the apprentice should be able to:

A. Oxyacetylene Welding

1. Iron and steel

1 Hour

1. List the sources of iron.
2. Explain the production of:
 - (a) pig iron
 - (b) cast iron
 - (c) wrought iron
 - (d) steel
3. Explain the following processes:
 - (a) bessmer
 - (b) open hearth
 - (c) electric furnace
 - (d) blast furnace
4. Define:
 - (a) crucible steels
 - (b) killed steels
 - (c) semi-killed steels
 - (d) rimmed steels
 - (e) capped steels
 - (f) cast steels
5. Interpret mill certificates.

2. Steel identification

1 Hour

1. List the carbon content and the uses for:
 - (a) low carbon steel
 - (b) medium carbon steel
 - (c) high carbon steel
 - (d) very high carbon steel
2. List five common methods that may be used to determine the composition of metals.
3. List six organizations involved in writing specifications of metals.
4. Demonstrate an ability to locate and interpret effects of alloying elements in steel.
5. Demonstrate an ability to locate and interpret data for:
 - (a) sheet steel
 - (b) steel bars

3. Heat and temperature

1 Hour

1. Explain the difference between heat and temperature.
2. Explain three forms of heat transfer.
3. Describe the effects of expansion and contraction.
4. Describe the purpose and effects of:
 - (a) preheating
 - (b) post heating

4. Heat treatment

1 Hour

1. Explain the process and effects of:
 - (a) stress relieving
 - (b) normalizing
 - (c) annealing

TOPIC

COURSE OBJECTIVES

- (d) hardening
- (e) tempering

5. Hardsurfacing

Hours

1. Describe the principle of hardsurfacing.
2. List the types of wear.
3. Demonstrate an ability to locate and interpret references for hardsurfacing materials.
4. Describe the procedures for applying hardsurfacing materials.

6. Welding symbols

4 Hours

1. Draw and interpret the sizing of fillet welds.
2. Transpose a welding symbol onto an illustration and vice versa.
3. Draw and interpret:
 - (a) sizes of groove welds
 - (b) sizes of root gaps
 - (c) depth of preparation and
 - (d) depth of penetration
4. Transpose a weld symbol onto an illustration and vice versa.

7. Lab practices

34 Hours

(a) butt welds

1. Demonstrate the ability to perform butt welds on 10 ga or 11 ga (3.00 mm — 3.25 mm) mild steel in the flat, vertical horizontal and overhead positions using a comparable filler material.
2. Demonstrate the ability to perform butt welds on 3/8" (10 mm) grey cast iron in the flat position using a comparable filler material and in the 45° vertical position using a coated tobin bronze filler material.
3. Demonstrate the ability to perform butt welds on 2" or 3" schedule 40 mild steel pipe in the 5G and 2G position using a comparable filler material.

(b) lap weld

1. Demonstrate the ability to perform lap welds on 10 ga or 11 ga (3.00 — 3.25 mm) mild steel in the vertical position using a coated tobin bronze filler material.

(c) demonstrations

1. Observe and explain the principle of hardsurfacing.
2. Observe and explain the principle of temperature indicating crayon.

B. Shielded Metal Arc Welding

1. Metallic arc welding of cast iron

2 Hours

1. Describe the major difficulties encountered when welding cast iron.
2. List the electrodes that may be used for arc welding cast iron.
3. Describe the welding procedures for welding cast iron.

2. Distortion

1 Hour

1. Define distortion.
2. Describe the mechanical ways of controlling distortion.
3. Describe the procedural ways of controlling distortion.
4. Describe how distortion may be controlled by design.

3. Alloy electrodes

2 Hours

1. Define alloy steel electrodes.

TOPIC

COURSE OBJECTIVES

2. Explain the purpose of prefixes and suffixes.
3. Demonstrate the ability to locate and interpret stainless steel electrode designations.
4. Select the correct electrode for alloying materials.

4. Mechanical and physical properties of metal

1 Hour

1. Define mechanical properties as they relate to:
 - (a) ultimate tensile strength
 - (b) elasticity
 - (c) yield point/strength
 - (d) ductility
 - (e) hardness and toughness
2. Define physical properties as they relate to:
 - (a) density
 - (b) corrosion resistance
 - (c) coefficient of expansion
 - (d) conductivity

5. Lab practices

62 Hours

(a) butt welds

1. Demonstrate the ability to perform butt welds in the flat, vertical and horizontal positions on 3/8" (10 mm) mild steel using an E6010 or E6011 filler material.
2. Demonstrate the ability to perform a butt weld in the vertical position on 3/8" (10 mm) mild steel using an E7018 filler material.

(b) lap welds

1. Demonstrate the ability to perform lap welds in the vertical, flat and horizontal overhead on 3/8" (10 mm) mild steel using an E6010, or E6011 and an E7018 filler material.

C. Gas Tungsten Arc Welding

1. Equipment

1 Hour

1. State the power sources that may be used for gas tungsten arc welding.
2. Describe the functions of the control panel.
3. Explain the uses of:
 - (a) A.C. current
 - (b) D.C. current
 - (c) high frequency current
4. Explain the basic operation of gas tungsten arc welding.
5. Describe the function of the torch.
6. Explain the purpose and operation of regulators and flow meters.

2. Defects

1 Hour

1. Demonstrate the ability to identify and rectify weld faults relative to gas tungsten arc welding.

3. Electrodes

2 Hours

1. Explain the purpose and the type of electrode used for gas tungsten arc welding.
2. Identify electrodes by color code and explain the application.
3. Explain and demonstrate the care of electrodes.

4. Shielding gas

1 Hour

1. Explain the purpose of the shielding gas.
2. Demonstrate the ability to select and interpret the application and effects of the different shielding gases.

TOPIC	COURSE OBJECTIVES
5. Filler metal	1 Hour 1. Identify and select the appropriate filler metal for a given base metal. 2. Demonstrate the ability to locate and interpret filler metal designations.
6. Safety	2 Hours 1. Explain the protection required while welding. 2. Demonstrate the ability to locate information regarding ventilation.
7. Lab practices (a) lap welds	29 Hours 1. Demonstrate the ability to perform lap welds on mild steel, stainless steel and aluminum in the flat, vertical, horizontal, horizontal overhead and 45° overhead positions using a comparable filler material. 2. Demonstrate the ability to perform butt welds on mild steel, stainless steel, and aluminum in the flat, vertical and horizontal position using a comparable filler material.
D. Trade Problems	15 HOURS
1. Review	1. Solve problems using: (a) whole number (b) fractions and (c) decimals 2. Solve problems related to: (a) percentages and ratio (b) perimeters and area (c) volumes (d) conversions
2. Conversions	1. Convert angular (degree) measurements to linear measurements.
3. Estimating (a) sheet and bar steel	1. Estimate by comparison the weight of standard sheet and bar steel. 2. Calculate the cost of steel sections given the price per unit weight.
E. Pattern Development and Blueprint Reading	27 HOURS
1. Equipment and supplies	1. Describe and use: (a) set squares (b) compass (c) ruler and pencils
2. Lines	1. Identify and utilizes: (a) visible lines (b) center lines (c) dimension and extension lines
3. Orthographic projection	1. Interpret the six views of orthographic projection. 2. Identify and describe the three most common views. 3. Sketch simple objects in orthographic projection.
4. Dimensioning	1. Explain and apply the application of dimensioning relative to: (a) aligned (b) unidirectional (c) base line (d) angular
5. Pictorial drawings	1. Sketch objects in: (a) isometric (b) oblique (c) perspective

TOPIC	COURSE OBJECTIVES
6. Geometry (a) circle	1. Identify and name the various parts of a circle. 2. Divide a circle into equal parts. 3. Calculate the center of a circle.
7. Angle construction	1. Construct a 90° and 60° angle using a compass. 2. Bisect an angle.
8. Layout (a) plate (b) flange (c) elliptical (d) cone and hopper development	1. Utilize angle construction in the layout of cover plates. 1. Layout a flange and determine the bolt holes. 1. Develop a pattern for an elliptical opening. 1. Draw patterns from an orthographic drawing for a cone and hopper.
9. Pipe layout	1. Calculate the angle of cut, measure — back, and length of pieces for a: (a) 2 piece — 90° (b) 3 piece — 60° (c) 4 piece — 90° 2. Mark out pipe using a wrap around to dimensions calculated.
10. Practical project	1. Demonstrate the ability to apply in a shop setting, a template developed during the course.
F. Rigging	6 Hours
1. Safety	1. Describe the effect that sling angles have on safe lifting. 2. Be able to identify the load limits of commonly used wire rope slings and synthetic slings. 3. Describe the causes and effects of shock loading on rigging. 4. Identify Occupational Health and Safety Regulations regarding safety factors.
2. Cable, rope and plate clamps	1. Describe the proper care and use of: (a) wire rope (b) synthetic rope (c) chains 2. Describe the correct use of plate clamps. 3. Describe the correct procedure for applying clips.

THIRD PERIOD TECHNICAL TRAINING WELDER TRADE

TOPIC

COURSE OBJECTIVES

Upon successful completion of each section the apprentice should be able to:

A. Shielded Metal Arc Welding

1. Stainless steel

5 Hours

1. List three major types of stainless steel.
2. Identify the three major types of stainless steel with the appropriate A.I.S.I. numbering system.
3. Define E.L.C. filler metals.

(a) preparation

1. Explain the procedures for preparing stainless steel for welding.

(b) carbide precipitation

1. Explain carbide precipitation and list ways of overcoming this characteristics.
2. Explain the effects of stabilizers in stainless steel.

(c) electrodes

1. Demonstrate the ability to locate and interpret the stainless steel electrode designations.

2. Nickel alloys and clad steels

2 Hours

1. Explain the effects that nickel has when added to steel.
2. Explain the welding procedure for nickel alloys.
3. Demonstrate the ability to locate and interpret in reference material the selection of appropriate filler material.
4. Explain the defects and how to overcome these defects when welding nickel alloys.
5. List ways of hardening nickel and nickel alloys.
6. Describe clad steels and list advantages.
7. Demonstrate the ability to locate and interpret the types of backing steel and types of cladding.
8. Explain the preparation and welding procedure for clad steels.

3. Special processes

2 Hours

1. Explain the basic principles involved with robotic welding.
2. List the advantages/disadvantages of robotic welding.
3. Explain the basic principles involved with laser welding and cutting.

4. What's in a weld

10 Hours

1. Define the terms:
 - (a) base metal
 - (b) steel
 - (c) alloy
 - (d) iron
2. Explain the production of steel.
3. Explain the effects of:
 - (a) carbon in steel
 - (b) manganese in steel
 - (c) phosphorus in steel
 - (d) sulfur in steel
4. Demonstrate the ability to locate and interpret from reference material steel specifications.

TOPIC

COURSE OBJECTIVES

5. State the organizations that write the steel specifications for:
 - (a) sheet and bar steel
 - (b) bar steels
 - (c) steel plates

5. Codes

12 Hours

(a) A.S.M.E.

1. Demonstrate the ability to locate and interpret the A.S.M.E. codes section VIII regarding:
 - (a) general requirements for all methods of construction and all materials
 - (b) requirements pertaining to methods of fabrication of pressure vessels
 - (c) requirements pertaining to classes of materials
 - (d) mandatory appendices
 - (e) nonmandatory appendices
 - (f) article 2 — radiographic examination
 - (g) article 5 — ultrasonic examination
 - (h) article 6 — liquid penetrant examination
 - (i) article 7 — magnetic particle examination
2. Demonstrate the ability to locate and interpret the A.S.M.E. code section IX regarding:
 - (a) article I — welding general requirements
 - (b) article II — welding procedure qualifications
 - (c) article III — welding performance qualifications
 - (d) article IV — welding data

(b) C.S.A.

1. Demonstrate the ability to locate and interpret the C.S.A. code W47.1 regarding:
 - (a) scope, definitions and administrations
 - (b) divisions
 - (c) certification procedures and requirements
 - (d) welding engineering standards, procedure data
 - (e) qualifications of a fabricator's welding procedure
 - (f) qualification of welders and welding operators
2. Demonstrate the ability to identify and recognize as reference material the C.S.A. code W59, and C.S.A. 48.

6. Lab practices

93 Hours

(a) butt welds

1. Demonstrate the ability to perform butt welds in the overhead and horizontal position on 3/8" (10 mm) mild steel using an E6010 or E6011 filler material.
2. Demonstrate the ability to perform butt welds in the vertical position on 3/8" (10 mm) mild steel using an E7018 filler material.
3. Demonstrate the ability to perform butt welds in the 45° overhead position on 3/8" (10 mm) mild steel using an E6010 or E6011 filler material for penetration pass and using an E7018 filler material for each sequential pass.

(b) pipe

1. Demonstrate the ability to prepare and perform butt welds on 6" schedule 80 pipe. These welds will be performed with the pipe in the 2G, 5G and 6G positions using an E6010 or E6011 filler material. As an alternative an E6010 filler material may be used for the penetration pass and using an E7018 filler material for each sequential pass.
2. Demonstrate the ability to operate safely an oxyacetylene cutting torch by cutting on 3/8" (9 mm) mild steel.
 - (a) a 30° beveled hole to accept a 2" pipe
 - (b) a 30° straight line bevel
 - (c) a cape to fit a 4" channel

TOPIC	COURSE OBJECTIVES
B. Gas Tungsten Arc Welding	24 Hours
1. Lab practices	1. Demonstrate the ability to perform lap welds on mild steel, stainless steel and aluminum in the flat, vertical, horizontal overhead and 45° overhead positions, using a comparable filler material.
(a) review	2. Demonstrate the ability to perform butt welds on mild steel, stainless steel and aluminum in the flat, vertical and horizontal position using a comparable type of filler material.
(b) pipe welds	1. Demonstrate the ability to prepare and perform butt welds on four inch schedule forty pipe. These welds will be performed with the pipe in the 2G, 5G, and 6G positions. The penetration pass will be performed using the gas tungsten arc welding process and a comparable filler material. An E7018 filler material will be used for each sequential pass.
C. Blueprint Reading	48 Hours
1. Review	1. Recall and define concepts learned in first and second period technical training relative to layout, blueprint reading and mathematics.
2. Scale drawings	1. Calculate the line length and actual length on a drawing which has been drawn to scale.
3. Views	1. Interpret and use: <ul style="list-style-type: none"> (a) section views (b) auxiliary views (c) details views
4. Symbols and abbreviations	1. Interpret and use symbols used in industrial drawings. 2. Recognize and interpret abbreviations used on blueprints.
5. Spool sheets	1. Explain the purpose of a spool sheet.
(a) symbols	1. Interpret symbols that represent individual components on a spool sheet.
(b) directional orientation	1. Interpret relative position and orientation of piping systems from an isometric drawing.
(c) dimensional information	1. Interpret component sizes in a piping system from a spool sheet.
(d) spool drawing	1. Draw sketches of piping assemblies in schematic form from an isometric drawing. 2. Compile a material list for a simple piping system.
6. Practical project	1. Construct from a spool sheet a project of the training establishment origin.
7. Reading blueprints	
(a) structural drawings	1. Interpret structural drawings of training establishments origin.
(b) vessel drawing	1. Interpret vessel drawings of training establishments origin.
D. Trade Science	12 Hours
1. Mechanical testing	1. List five mechanical testing methods and the properties measured by each method.
(a) mechanical properties	
(b) stress and strain	1. Define stress and strain and calculate stress and strain under a tensile load.
(c) modules of elasticity and ductility	1. Calculate the stiffness of an tensile specimen. 2. Calculate the percent elongation of a tensile specimen.

TOPIC	COURSE OBJECTIVES
(d) fatigue and creep	<ol style="list-style-type: none"> 1. Explain the conditions under which fatigue and creep failures occur. 2. Define fatigue strength and endurance limit.
(e) impact testing	<ol style="list-style-type: none"> 1. Describe the effect of a dynamic load and low temperature on toughness. 2. Define and measure the transition temperature.
(f) hardness testing	<ol style="list-style-type: none"> 1. Describe the Rockwell and Brinell methods of indentation hardness testing. 2. Explain how hardness testing is used to determine heat treatment and ultimate tensile strength.
2. Nondestructive testing	
(a) radiography	<ol style="list-style-type: none"> 1. Explain how x-rays and gamma-rays are produced. 2. List the factors that affect the quality of the radiograph. 3. Describe how a penetrometer is used to measure radiographic quality. 4. Describe how typical weld defects will appear on a radiographic image.
(b) ultrasonics	<ol style="list-style-type: none"> 1. Describe the principle of flaw detection in a weld. 2. Describe the principle of thickness gauging.
(c) magnetic particle	<ol style="list-style-type: none"> 1. Describe how magnetic particle testing would be used to detect defects in weldments.
(d) dye penetrant	<ol style="list-style-type: none"> 1. Describe the application and principle of penetrant testing.
3. Welding metallurgy	
(a) micro-structures	<ol style="list-style-type: none"> 1. Define and describe typical micro-structures such as: <ol style="list-style-type: none"> (a) columnar grains (b) grain growth (c) heat affected zone (d) grain refinement (e) weld defects
(b) micro-structures	<ol style="list-style-type: none"> 1. Define and describe typical micro-structures such as: <ol style="list-style-type: none"> (a) grain (b) grain boundary (c) ferrite (d) pearlite (e) martensite (f) austenite 2. Describe various heat treatments and their effects on mechanical properties such as: <ol style="list-style-type: none"> (a) annealing (b) normalizing (c) quenching (d) tempering (e) stress relieving

SUGGESTED REFERENCE MATERIALS

The Metal Trades Handbook (IPT Industrial Publishing and Training Consultants Ltd.)

Metals and How to Weld Them (Welding Engineer Publication Inc.)

Arc Electrode Manual (Jefferson Publishing, Inc.)

The Welding Encyclopedia (Monticello Books, Inc.)

Welding Technology (Howard W. Sams and Co. Inc.)

General Mathematics for the Shop (Thomas Nelson and Son Publishing Co.)

Blueprint Reading for Welders (Delmar Publishing Co.)

Orthographic Projection Simplified (McKnight and McKnight Publishing Co.)

Occupational Health and Safety Regulations (Queen's Printers)

TECHNICAL TRAINING SCHOOLS

The Welder apprenticeship training program is offered by Alberta Manpower, Apprenticeship and Trade Certification. Staff and facilities for teaching the program are supplied by:

1. Northern Alberta Institute of Technology
2. Southern Alberta Institute of Technology
3. Lethbridge Community College
4. Keyano College
5. Lakeland College
6. Fairview College
7. Medicine Hat College
8. Red Deer College

**LOCATION OF APPRENTICESHIP AND TRADE
CERTIFICATION REGIONAL OFFICES**

BONNYVILLE

CALGARY

EDMONTON

FORT McMURRAY

GRANDE PRAIRIE

HINTON

LETHBRIDGE

MEDICINE HAT

PEACE RIVER

RED DEER

VERMILION

GOVERNMENT OF THE PROVINCE OF ALBERTA

ALBERTA REGULATION 87/81

(Filed on February 23, 1981)

THE MANPOWER DEVELOPMENT ACT

ALBERTA ADVANCED EDUCATION AND MANPOWER

MINISTERIAL ORDER

I, James D. Horsman, Minister of Advanced Education and Manpower, pursuant to sections 30(2) and 37(2) of The Manpower Development Act, make the regulation in the attached Appendix, being the Welder Trade Regulation.

Dated at the City of Edmonton, in the Province of Alberta, this 16th day of February, 1981.

JAMES D. HORSMAN,
Minister of Advanced Education and Manpower.

APPENDIX

THE MANPOWER DEVELOPMENT ACT

Welder Trade Regulation

1(1) In this regulation

- (a) "welder" means a person engaged in the cutting, heating, straightening and joining together of ferrous and non-ferrous metals by fusion and adhesion processes;
- (b) "General Regulations" means the General Regulations under *The Manpower Development Act* (Alta. Reg. 43/77).
- (c) "trade" means the trade of welder.

(2) The definitions in the General Regulations apply in this Regulation.

PART 1

APPRENTICESHIP AND TRADE TRAINING

2 A person is eligible to be an apprentice welder if he has

- (a) satisfied the requirements of section 5 of the General Regulations, and
- (b) either
 - (i) produced evidence of at least a grade 9 education, or
 - (ii) passed the entrance examination prescribed by the Board.

3(1) Subject to subsections (2), (3) and (4), a person engaged in the trade and who is a journeyman, or who employs a journeyman, may employ one apprentice and may employ one additional apprentice for each additional journeyman he employs.

(2) If the supply of journeymen in a location where an employer is carrying on business is insufficient to permit the employer to carry out his work commitments, the Director may authorize the employer to employ apprentices in addition to those permitted under subsection (1).

(3) The Director may authorize an employer to employ an apprentice in addition to those under subsection (1), on a temporary basis, to train him in a branch of the trade not engaged in by the employer to whom he is apprenticed.

(4) An apprentice employed temporarily under subsection (3) shall not, for the purpose of subsection (1), be considered to be an apprentice of his temporary employer.

4(1) The term of apprenticeship shall consist of 3 periods of 12 months each.

(2) Each period referred to in subsection (1) shall consist of not less than 1800 hours of employment, inclusive of time spent attending technical courses prescribed by the Board.

(3) The Director may not, under section 25(1) of the Act, reduce the term to be served by an apprentice to less than one period of apprenticeship.

5 When a contract of apprenticeship is registered with the Director, he shall issue to the apprentice an official record book referred to in section 14 of the General Regulations.

6(1) An apprentice shall not advance to the next period until the Director has authorized him to do so by making an entry in the apprentice's official record book under subsection (2).

(2) The Director shall make an entry in the apprentice's official record book authorizing advancement to the next period, when the apprentice

- (a) has completed the previous period of apprenticeship.
- (b) has received, in the opinion of the Director, a satisfactory report from
 - (i) his employer, and
 - (ii) the school at which he attended technical training courses prescribed by the Board.
- (c) has completed the trade tests and examinations prescribed by the Board, and
- (d) has attained pass marks prescribed by the Board in the tests and examinations referred to in clause (c).

7 The official record book of an apprentice shall be kept in the possession of the employer and, upon termination of the employment of the apprentice, the employer shall present the completed book to him.

8(1) An employer shall pay wages to an apprentice that are not less than the following percentages of the prevailing wages paid to a journeyman:

- (a) 60% in the first period;
- (b) 75% in the 2nd period;
- (c) 90% in the 3rd period;

(2) Notwithstanding subsection (1), the wages paid to an apprentice shall not be less than the minimum wage fixed pursuant to *The Alberta Labour Act, 1973*.

(3) An employer is not required to pay wages to an apprentice during the time that the apprentice spends attending technical training courses prescribed by the Board.

9 The hours of work and working conditions of an apprentice shall be the same as those of a journeyman.

PART 2

CERTIFICATION

10 The Director may issue the following classes of certificates in accordance with section 49 of the General Regulations:

- (a) Certificate of Proficiency;
- (b) Temporary Certificate.

11 In accordance with section 50(d) of the General Regulations, the Director may issue a Certificate of Proficiency without examination to a person who holds

- (a) a Certificate of Completion of Apprenticeship in the trade issued by another province within Canada, or
- (b) a Certificate of Qualification or a Certificate of Proficiency in this trade, issued by another province within Canada bearing an Interprovincial Standards Red Seal.

12(1) An application to take an examination for a Certificate of Proficiency shall be made to the Director.

(2) Documentary evidence acceptable to the Director shall be presented by an applicant for an examination showing that the applicant

- (a) holds a certificate equivalent to an Alberta Certificate of Proficiency issued by a Provincial authority outside Alberta, or
- (b) has at least 4 years of acceptable work experience in the trade.

(3) The applicant shall provide English translations acceptable to the Director, of credentials in a foreign language, submitted pursuant to subsection (2).

13(1) The Director may issue a Temporary Certificate to a person if

- (a) that person has complied with section 11,
- (b) the Director has approved the application for examination made under section 12(1), and
- (c) the applicant has attained a mark of not less than 70% of the pass mark on the examination prescribed by the Board.

(2) Notwithstanding subsection (1)(c), the Director may, when in his opinion extenuating circumstances warrant such action, issue a Temporary Certificate to a person who has attained a mark of less than 70% of the pass mark on the examination prescribed by the Board.

(3) Temporary Certificate entitles the holder to work as a welder under the supervision of a journeyman.

14 A Certificate of Proficiency issued under this regulation is effective unless cancelled or suspended by the Director in accordance with section 60 and 61 of the General Regulations, or section 48 of *The Manpower Development Act*.

15 Alberta Regulations 619/62 and 61/71 are repealed.

N.L.C. - B.N.C.



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